HIGH ARTERIAL PRESSURE: HIGH PRESSURE HYPERTROPHY OF THE HEART.[1]

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For a long time clinicians and pathologists in studying diseases of the circulation centred their attention almost exclusively on the heart. And even today we speak of heart failure, although we know that taken by itself such a thing is of extreme rarity. In the maintenance and control of the circulation the heart does not stand alone; it shares the responsibility with the bloodvessels, which participate actively in propelling the blood and in maintaining the blood pressure. The specific subject I wish to take out of this extensive and important field and discuss is high arterial pressure. I use this term instead of arteriosclerosis partly because the two are not synonymous, though often so used, and partly because the latter, arteriosclerosis, conveys the idea of an anatomic lesion, a terminal event best studied after death; while the former indicates at once a vital functional alteration with a direct bearing upon symptoms.

What do we mean by high arterial pressure? High arterial pressure is a relative term. Sex, age, and other factors must be taken into consideration. Up to a few years ago clinicians trusted to their fingers and eyes, but now we have fairly accurate and convenient devices by which we can determine quantitatively the amount of arterial pressure. The signal advantages of instrumental determination must be at once apparent. They are greater accuracy, standards of comparison, and ability to control treatment by recorded observations. The sphygmomanometer is to blood pressure what the hemocytometer and hemoglobinometer are to blood. Before we had them we knew of anemia, but had no definite standards and no basis for records. It is beyond the province of this paper to discuss the various instruments on the market. None is perfect; all are subject to the inevitable influence of the personal equation; but variations due to error are slight.

To know whether the blood pressure is high or not it is necessary to know the normal standards. These vary somewhat with different observers. The best records are probably those that have been obtained by careful insurance examiners, as such examiners deal more frequently than we do with healthy persons. Dr. Woley, of Chicago, in a study of 1000 healthy individuals, found the average to be as follows:

15 to 30 years	Blood pressure, 115 mm.
30 to 40 years	Blood pressure, 127 mm.
40 to 50 years	Blood pressure, 130 mm.

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[1] An address delivered by invitation before the Wayne County Medical Society, Detroit, Michigan, May 20, 1912.

For women of the same ages the blood pressure is from 8 to 10 mm. lower. Not only age and sex, but also mental state, posture, and many other factors have an influence. Under excitement the blood pressure may rise 20 to 30 or even more millimeters. Due allowance must always be made for these variable factors.

Clinicians differ as to the exact dividing line between normal and abnormal pressure. My own feeling is that, other things being equal, a pressure over 145 is abnormal. At the age of fifty a pressure of over 150 is pathologic. This does not mean that the patient is gravely ill, but it does mean that such a patient should be kept under observation and that the cause of the rise in blood pressure should be ascertained, for when it comes to arterial disease—particularly hypertension—prevention is better and easier than cure.

As guardians of the health of our patients we are not doing our full duty. We are still too much concerned in treating the sick; a laudable purpose in itself, but one not exhausting our possibilities for good. I need not discuss the utility of preventive medicine in general. We are all agreed on that. What I have particularly in mind is personal preventive medicine. By that I mean that we should make it our duty toward our individual patients and families to guard them against such ill health as timely examinations can anticipate. To this end we should urge the men and women of over forty years of age to send urine for examination two or three times a year and to have their blood pressure taken twice a year. If we can once induce those whom we should be called upon to treat if they were ill to see the value of such examinations to themselves, our usefulness to the community and our prestige, which many new creeds and fancies have somewhat impaired, would be greatly enhanced. I see no reason why medical officers of health should not add to their preachments about communal prophylaxis, appeals for personal prophylaxis against insidious diseases of non-infectious nature which when once detected are often beyond cure.

To return to our subject: When I stated above what I considered the limits between normal and abnormal blood pressure I was giving the results of personal experience and belief. I am in the habit of looking on a pressure of from 140 to 150 in a man aged between thirty and forty years as not altogether normal if it is found on several examinations, especially if the diastolic pressure is raised 20 or 30 mm. Here I must emphasize one point to which I have already alluded: under excitement or fear, or after a heavy meal, or after exercise, the pressure rises temporarily, at times as much as 50 mm. Due allowance must be made for such transitory variations. Only when the pressure is sustained at the same level under proper conditions of testing is it significant.

When we consider the causes of high arterial pressure we enter a field with few well-defined paths. Bright's disease, particularly the chronic interstitial variety, bears an unquestionable relationship to hypertension. But in what way the lesion of the kidney acts to bring this about is far from settled. Permanently high blood pressure is produced not only by the chronic interstitial form, the parenchymatous type also raises the blood pressure. I believe in such cases that estimation of the the blood pressure is often of great diagnostic and prognostic import. If we could explain the hypertension in nephritis we should also know the causes of the hypertrophy of the heart that is an almost constant feature of this affection. It may be remembered that the early view was that the restriction of the vascular area in the diseased and contracted kidney was responsible for the rise in blood pressure. This can scarcely be the case in view of the great adaptability of the circulation to slowly developing conditions; moreover the kidney circulation bears but a small ratio to the general vascular territory, and the local pressure restriction seems hardly capable of influencing general pressure to any marked degree.

Another view is that the disease of the kidney increases the viscosity of the blood, and hence the internal friction, and as a corollary the pressure against the vessel walls. It is quite possible that such heightened viscosity may be a factor, but the pressure is also raised under conditions in which the viscosity is presumably lessened: in chronic parenchymatous nephritis with dropsy and hydremia.

The theory that hypertension in nephritis is due to a contracted state of the vessels, the result of a generalized exaggeration of the vasomotor tonus, has had strong attractions for recent writers. It may be expressed by saying that in chronic nephritis some pressor substance circulates in the blood; either a new one or a previously existing one in increased quantity, which causes a spasm of the vessels. I see no flaw in this hypothesis except that the pressor substance is not unequivocally demonstrated. Many believe that it is adrenalin or epinephrin. While a number of investigators have found the adrenalin increased in nephritis, others have not. If there is an excessive amount in the blood, a hyperadrenalinemia, it remains yet to be explained why the adrenalin content is increased. Inasmuch as some recent investigators have found a pressor substance in the kidney itself, it is possible that through the melting down of renal tissue in Bright's disease such a substance may be liberated and taken up by the blood. Quite recently attention has been turned upon the liver in Bright's disease, as the belief is growing that the relation between that organ and the kidney is far closer than physiologists have held. It is to me not inconceivable that some of the symptoms of nephritis are connected with disturbed hepatic function. An attractive hypothesis could be erected on the theory that the kidney is an organ of internal secretion, but the paucity of facts does not warrant it. It can be seen then how far we are from a real knowledge of the cause of hypertension in Bright's disease.

Another cause of persistent hypertension is arteriosclerosis. So much has been said and written on this subject that I shall not discuss the clinical causes or the pathology. Let me state only that arteriosclerosis is both a general and a local process. Local arteriosclerosis, which may often be intense, is not necessarily accompanied by a rise in blood pressure. Thus we may have marked calcification and beading of the accessible arteries without hypertension, and, on the other hand, I have seen a considerable number of patients with impalpable arteries whose pressure was 200 mm. or more. These are the cases that are difficult to interpret. Sometimes careful and repeated examination of the urine will show evidence of chronic interstitial nephritis: abundant urine of subnormal specific gravity with a trace of albumin and a few hyaline casts. In others the urine is entirely normal. At times the quantity is slightly increased and a few hyaline casts are found in the centrifuged specimen. I lay no stress on a sparse number of casts, especially if the urine contains crystals of uric acid and oxalate of lime.

Now it is this particular group of hypertension cases to which I have just referred that is of interest and importance; the group without notable thickening of the superficial arteries and no renal changes of importance. It is common in men and comprises, in my own experience at least, a rather large proportion of women of middle age. Not until I began to look for it did I realize how common this non-sclerotic type of hypertension is in the female sex. Both the men and women with this affection are usually robust, stout to obese, and past fifty years of age. In none of my cases in women was syphilis or alcohol a factor. In men syphilis at times plays a part, but I do not think that alcohol is to be blamed. I do not mean to say that these patients do not drink, but I wish to convey the idea that I do not consider alcohol itself an important feature in the production of high arterial tension. In the majority of cases there had been mental strain and heavy responsibility. Some of the women had reared large families under difficulties. One curious circumstance may not be without significance. Nearly all the women had come, after years of privation, to live in comparative comfort because their sons, several of them physicians and lawyers, had been successful, and had dutifully made life easy for their mothers.

The symptoms complained of were usually respiratory or gastric in nature; rarely such as to direct attention to the heart and vessels. I have no statistical tables, but I have gained the impression that one-half to two-thirds came complaining of indigestion and bloating after meals. A majority of the remainder noticed shortness of breath on exertion, which they were inclined to ascribe to distention with gas. A few were first troubled with vertigo, with numbness and tingling of the extremities, or with ringing in the ears. The women in this group have interested me particularly because in few of them had the real nature of the affection been suspected. They had usually been treated for stomach trouble—flatulent dyspepsia or nervous indigestion.

Now what do we find on examination? The men are usually overweight, with large and solid-looking chests. They have an air of youthfulness and often much vitality. The women are large and have heavy, pendulous breasts. The heart is found enlarged, often far beyond what one would expect from either the symptoms or the physical appearance and capacity of the patient. The radials are either soft as in youth or a trifle thickened, like a thin-walled rubber tube. The temporals, which are rarely conspicuous in women, may not be abnormal. An arcus senilis is often present. The urine may not show anything of importance except a slight increase in quantity. The specific gravity will not vary much from the normal, but there is one factor of importance that I have noticed quite recently since my attention was called to it by Dr. Pratt, of Boston—namely, that these patients pass much larger amounts of urine during the night than in the daytime. I have a patient under observation at present who voids sometimes twice as much at night as in the daytime, the urine being measured separately from 8 A.M. to 8 P.M., and from 8 P.M. to 8 A.M. The blood pressure will be found high—from 190 to 260 or even more—far beyond what would be expected from an examination of the arteries.

The hypertrophy of the heart, which is always present, is not due to valvular disease. There are no endocardial murmurs except perhaps late in the course, when through loss of compensation the heart dilates and a mitral systolic murmur appears. Usually, indeed, almost without exception, the second aortic sound is much accentuated, and the first sound at the apex dull and heavy. The heart is generally regular. This type of hypertrophy is frequently overlooked, as I have had occasion to notice both in undergraduate and in postgraduate teaching. It is overlooked because many of us fail to palpate and to percuss the heart. I am inclined to believe that percussion and palpation of the heart are more important than auscultation.

Not rarely there is a systolic murmur at the aortic area without concomitant signs of aortic stenosis. The murmur indicates, I take it, sclerosis in the arch of the aorta. It is customary to make light of this murmur; justly so in the case of arteriosclerosis; but in the group with which I am dealing, in which there is no sclerosis in the peripheral vessels, the murmur, to my mind, has an important meaning. I believe the patients that have it are more liable to angina pectoris. This brings me to another important point of interest: these high-pressure cases that do not have visible or palpable arteriosclerosis during life are particularly prone to anginal attacks, to coronary sclerosis and thrombosis. A systolic murmur at the aortic area in such a patient is ominous of an early extension of the sclerotic process from the arch into the coronary artery; its presence therefore influences the prognosis.

The blood pressure, as I have said, is high, often startlingly so, in patients whose complaints are seemingly trivial. Thus I have under my care at present a widow, aged forty-seven years, with a systolic pressure of 265, soft arteries, a perfectly regular but enlarged heart, whose chief complaint is ringing in one ear. Not a few cases have been referred to me by ophthalmologic friends who detected retinal hemorrhages. Such hemorrhages, or rather the visual disturbances dependent upon them, are often the earliest symptoms of which the patient is cognizant. Ophthalmologists have learned to recognize these high-pressure cases by means of the ophthalmoscope. Many patients, however, have normal eye-grounds.

The course of this affection, which I have been bold enough to designate *high-pressure hypertrophy*, is largely governed by the state of the heart. As long as the latter is competent the circulation is maintained at its high level, often with a minimum degree of functional disturbance. Eventually, however, the *vis a fronte* becomes too great for the *vis a tergo*, and the heart yields and dilates. The subsequent events are practically identical with those of decompensation from any other cause, and need not detain us. No doubt the lessening of the resilience of the vessels and their failure to help in the proper movement of the blood is an important contributing factor in the downward course of events.

I have been impressed with the infrequency with which high-pressure cases suffer from apoplexy. It occurs, but more often in the younger than in the older patients. Death results either from total failure of compensation or from angina pectoris, unless some intercurrent malady anticipates these two.

What is the cause of this intereating syndrome—this high-pressure hypertrophy? At first sight it looks as if there must be some pressure-raising substance in the blood. I have been hoping that some method of detecting this could be adapted to clinical application so that the theory might be tested. At present the methods are too complicated. In many cases there is, I believe, arteriosclerosis of certain important vascular territories—namely, the aortic arch and the splanchnic vessels. How sclerosis of the former raises pressure, if it does so, is a mystery. I am not sure that the ingenious hypothesis of Bittorf solves it.[2]

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[2] Bittorf believes that a possible cause of high arterial pressure is degeneration of the depressor nerve or its terminations in the arch of the aorta. The depressor nerve is an afferent nerve carrying impulses to the brain, in response to which the peripheral arterial pressure is lowered through vasodilatation. When the nerve is diseased the system naturally loses this important "factor of safety."

Sclerosis of the splanchnic vessels, on account of the great area of this system, is undoubtedly capable of raising the pressure. It is likewise possible that with sclerosis of this territory some changes take place in the suprarenal glands by which the blood pressure is affected. At any rate, sclerosis of the splanchnic vessels is not uncommon, and perhaps some of the gastric distress and abdominal pains of which the patients complain may find their explanation on that basis.

I shall not dwell on the hypertension accompanying the more obvious types of arteriosclerosis. The clinical differences are not great and the diagnosis is much easier. Angina pectoris is not so common with pipe-stem peripheral arteries; apoplexy is more frequent.

TREATMENT. The treatment of hypertension is a subject of great practical importance upon which there is as little unanimity as upon most other subjects of medical practice. I have already discussed means of prevention, an object possible of accomplishment when the taking of blood pressure becomes a habit and when the laity learn to realize the importance of paying for medical advice before it is imperative to have it.

It should be borne in mind that the high pressure, like much of Nature's work in the body, is compensatory and reparative. Hence any attempt to depress the blood pressure to its normal for the individual is both irrational and harmful. All that we may safely attempt to do is to lower the blood pressure when it is excessively high to a point where symptoms cease and to keep it there. Serious consequences have followed when a pressure of 240, for example, was knocked down medicinally and precipitately to 150. Let us see what we can do to lower hypertension to a reasonable level. If we knew the direct cause we might combat it. As we do not know it we must work indirectly. First and foremost in my mind is rest, mental rest being more important than physical rest, although the latter has its place. It is astonishing what relief from the "weariness, the fever and the fret" will accomplish. Sometimes driving a patient to make a decision in a critical matter, so as to have it over with, accomplishes more than any medicine.

The diet is of importance, but more from the point of view of quantity than of quality. Many patients with hypertension have a habit of overeating, and suffer from what Sir Clifford Allbutt calls "hyperpiesis." And it may be wise to restrict somewhat the nitrogenous, more particularly the purin-containing foods. A valuable admonition is that the patient should eat a small evening meal—he will rest much better. In regard to stimulants, I am more afraid of tobacco than of alcohol, but usually restrict both, as the case may require. I do not think tea or coffee is good for these patients, a fact they often discover for themselves. The bowels must be kept open. No one remedy or measure can be employed for all cases. The salines are useful. Many persons get comfort from a pill of phenolphthalein and rhubarb, or from the well-known compound liquorice powder. An occasional dose of calomel or blue mass serves a useful purpose. Special baths are of doubtful value, and I question particularly whether the Turkish bath so frequently employed does any good. A simple hot bath or a short electric cabinet bath may at times be of benefit, but the latter ought not to be left to the uncontrolled discretion of the patient.

Electricity in the form of the high-frequency current (autocondensation) has a growing number of advocates. My use of this is of such recent date that I have no personal opinion.

As for drugs, even the laity are familiar with the value of the nitrites, and are no longer frightened when nitroglycerin is prescribed. There are cases in which nitroglycerin fails. In these cases sodium nitrite in doses of from $\frac{1}{8}$ to 2 or even 3 grains may prove useful. Erythrol tetranitrate is a powerful vasodilator in doses of one-half grain, but often produces a painful fulness in the head, to which patients object seriously. The nitrite group of remedies is to be used only to relieve symptoms, which they often do—especially nocturnal dyspnea—in a remarkable manner. The continued use of the nitrites is of doubtful utility unless the pressure is rising, or there is angina pectoris, or marked dyspnea. In such cases they may be given over a long period in large doses.

The iodides are much in use. I give them routinely, though their method of action is unknown. Perhaps they reduce the viscosity of the blood. I prefer the sodium salt given two hours after meals, in water or milk. I find the newer iodine-containing tablets convenient, especially for persons who travel.

Digitalis might appear to be contraindicated in the cases of hypertension with which I am dealing, but strange as it may seem, many patients who are suffering from dyspnea and even from vertigo do well on small doses of digitalis. I prefer either the tincture in from 5 to 10 mm. doses three times a day, or the powdered leaves ($\frac{1}{4}$ to 1 grain).

There is one more measure in the value of which I have an abiding faith—namely, venesection. At the Philadelphia General Hospital venesection never went entirely out of use, and in the last score of years it has again become popular and is winning its way into general practice. It is safe to abstract in such cases up to a pint of blood, and if the pressure instrument is kept on the arm and the pressure controlled, we may take off 20 or 24 ounces. The relief from symptoms is often magical.

A number of European health resorts enjoy a great popularity in the treatment of hypertension and other cardiovascular conditions. Personally I doubt whether there is anything specific in their waters or in their baths; but freedom from care, regular hours, and greater frugality of living are probably the factors that achieve the good results.